

**CLAIMS:**

1. A biocompatible support structure for culturing cells in three dimensions, which comprises a biocompatible and non-biodegradable polymeric material on  
5 which cells may adhere and proliferate, and which forms, when saturated in a suitable aqueous medium, a porous tridimensional sponge-like scaffold with a plurality of interconnected pores, said pores being dimensioned and distributed so that a flow of at least  $0.1 \text{ ml/min}^{-1}\text{cm}^{-2}$  of an aqueous solution may circulate through said biocompatible support structure, characterized in that said polymeric  
10 material consists of a cross-linked polyvinylalcohol (OVA) derivatized with alkylamino groups.
2. The biocompatible support structure of claim 1, wherein said pores are dimensioned and distributed so that a flow of at least  $0.5 \text{ ml/min}^{-1}\text{cm}^{-2}$  of an  
15 aqueous solution may circulate through the biocompatible support structure.
3. The biocompatible support structure of claim 2, wherein said pores are dimensioned and distributed so that a flow of about 1 to about  $15 \text{ ml/min}^{-1}\text{cm}^{-2}$  of an aqueous solution may circulate through the biocompatible support structure.  
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4. The biocompatible support structure of claim 1, wherein said pores have a diameter of about 100 to about  $1000 \mu\text{m}$ .
5. The biocompatible support structure of claim 1, wherein it comprises from  
25 about 20 to about  $50 \text{ pores/cm}^2$ .
6. The biocompatible support structure of claim 1, wherein said cross-linked polyvinylalcohol (PVA) is derivatized by reacting its hydroxyl functions with an haloalkyl amine.  
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7. The biocompatible support structure of claim 6, wherein said haloalkyl amine is selected from the group consisting of 2-chloroethylamine hydrochloride,

chloropropyl amine, bromoethylamine and iodoethylamine.

8. The biocompatible support structure of claim 1, wherein said support structure further comprises an associated polymer selected from the group consisting of polyethyleneglycol (PEG), agarose, starch, alginate, and chitosan.

9. The biocompatible support structure of claim 1, wherein said support structure further comprises a bioactive molecule selected from the group consisting of: extracellular biocompatible support structure proteins, growth factors, hormones, signaling molecules, peptide binding motifs of receptors, carbohydrates, and carbohydrates derivatives.

10. The biocompatible support structure of claim 1, wherein said cells consist of mammalian cells.

11. The biocompatible support structure of claim 10, wherein said mammalian cells consist of human cells.

12. The biocompatible support structure of claim 1, wherein said cells are selected from the group consisting of hepatocytes, cardiomyocytes, fibroblasts, osteoblasts, cancer cells, monoclonal cells, kidney cells, and pancreatic cells.

13. A bioartificial organ, comprising:

- a biocompatible support structure; and
- living cells which are adhered and which can proliferate on said support structure,

wherein said support structure is as defined in claim 1.

14. The bioartificial organ of claim 13, wherein said living cells consist of mammalian cells.

15. The bioartificial organ of claim 14, wherein said mammalian cells consist of

human cells.

16. The bioartificial organ of claim 13, wherein said living cells are selected from the group consisting of hepatocytes, cardiomyocytes, fibroblasts, osteoblasts, cancer cells, monoclonal cells, kidney cells, and pancreatic cells.

17. The bioartificial organ of claim 16, wherein said bioartificial organ consists of a bioartificial liver, a bioartificial kidney or a bioartificial pancreas.

18. A device for culturing cells of the type comprising:

- a waterproof housing through which a culture medium can circulate, the housing having an inlet and an outlet capable of a waterproof connection to pumping means; and
- a biocompatible support structure that is enclosed into said waterproof housing;

characterized in that said biocompatible support structure is as defined in claim 1.

19. A tridimensional cell culture system comprising:

- cells for which culture in three-dimension is desired;
- a culture medium that is suitable for the *in vitro* or *ex vivo* culture of said cells;
- a device for culturing cells as defined in claim 18; and
- pumping means for circulating a culture medium through said device.

20. The system of claim 19, characterized in that said cells are selected from the group consisting of hepatocytes, cardiomyocytes, fibroblasts, osteoblasts, cancer cells, monoclonal cells, kidney cells, and pancreatic cells.